

**Interaction of Photonic Crystals and Quantum Dots:  
Killer Application to Integrated Ultra-Fast  
All-Optical Signal Processors**

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First demonstration of an ultra-small and ultra-fast symmetric Mach-Zehnder type all-optical switch (PC-SMZ) based on an interaction between nonlinear quantum dots and photonic crystals is reviewed. Technologies essential for achieving such an integrated photonic device are discussed in the field from precise nano-fabrication of GaAs-based two-dimensional photonic crystal slab waveguides to functional waveguide design in light of patterning the SMZ configuration. As a result, transmission spectra in good agreement with calculation and low propagation loss of less than 1 dB/mm are reproducibly exhibited, while directional couplers with arbitrary and wavelength-dependent coupling strengths play important roles of practical beam splitters/couplers. Through the switching operation of the PC-SMZ, possibility of far advancement of the 2DPC-based integrated circuits is concluded.

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